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CLIMATE AND MAN IN THE COLUMBIA PLATEAU AREA

J. WRIGHT BAYLOR
University of Washington

When one finds himself in the midst of a blinding sandstorm on the Central Washington desert as he winds his way thru the purple sage, startling the jack-rabbit from his place of refuge on the leeward side of a desert shrub, one cannot fail to appreciate the dominance of climate as a controlling factor in man's activity. In face of such desolation and waste, the few settlers now inhabiting this desert are forced to locate their places of abode, as are the tribes of the Sahara, in relation to the few available sources of water.

Such a settlement is the one at Moses Lake which within the last five years, thru irrigation, has become a thriving fruit district. Outside such oases, deserted cabins, dilapidated fences, abandoned fields, unbroken stretches of sage (Figs. 2-3), all bear mute testimony of man's failure to utilize these lands unless water is procurable.

Why, then, did people ever attempt farming such an area? It was the rainfall of the years 1900-9, which, being heavier than usual, resulted in a few excellent crops. The success of the pioneers induced other settlers to rush into the area, clear the sage, and plant extensive fields of wheat. Within a few seasons the rainfall declined to normal, and the boom period ended for all places except where the seasonal rainfall was dependable or where irrigation was possible.

Today, at the same time sandstorms may be raging in this once prosperous area, farmers less than forty miles to the east are busily engaged in harvesting a thirty bushel crop. These illustrations indicate not only the control of climate over man's activities in this area, but also that the Columbia Plateau which slopes gently

westward from the foothills of the Bitter Roots cannot be considered as one geographic unit. Altho this region embracing the Big Bend and Palouse Countries and Columbia Basin District (Fig. 1) is generally regarded as the Washington wheat belt it may be sub-divided into four human use areas. In each of the following

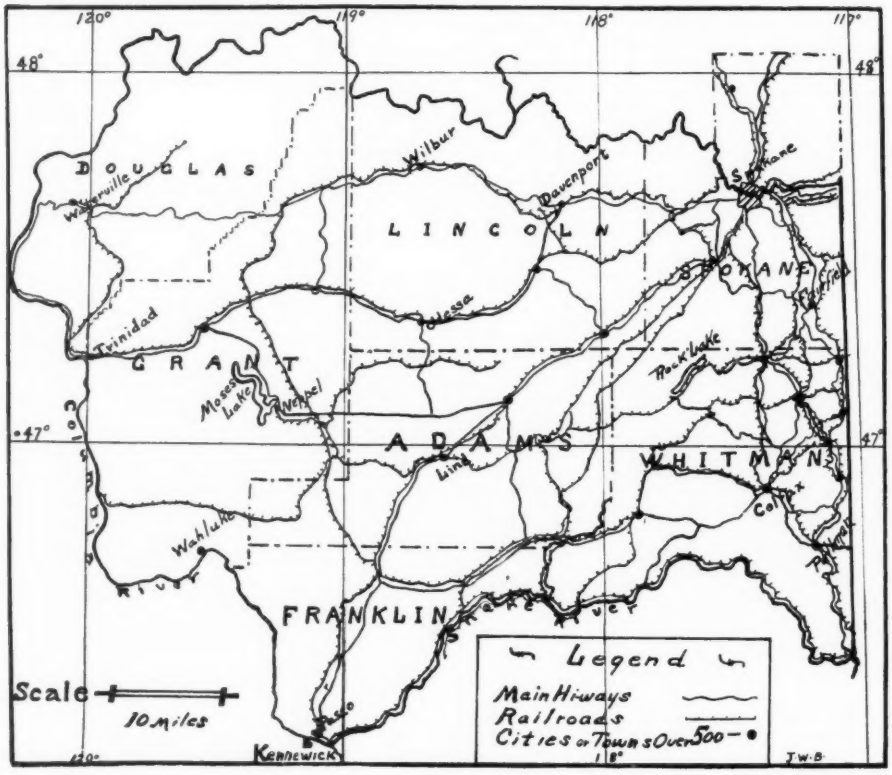

FIG. 1. Place map of the Columbia Plateau of eastern Washington. Note the great increase in roads and towns progressively from west to east.

areas the types of human adjustment which predominate are almost wholly a result of climatic controls.

1. Upland oases and irrigated river terraces of the periphery.
2. The desert area which has less than eight inches of rainfall.
3. The marginal wheat belt.
4. The reliable wheat growing area which has over twelve inches of rainfall.

GENERAL CHARACTERISTICS OF THE CLIMATE OF THE ENTIRE AREA

The particular location of this inland area gives rise to a climatic type which is, according to Huntington, most favorable to energetic human activity. However, it does not follow that the characteristics of the climate are equally favorable to agricultural pursuits. Altho the climate is favorable to human activity in the entire area its regional variations are by far the most pronounced factors controlling the success or failure of agriculture.

Spokane, a type city, has the highest annual mean of interior cities so far north. The summer mean of 67° places it on the isotherm running thru the middle of the Great Lakes region and the heart of the Adirondack summer resort district, while the winter mean is similar to that of Kansas City.[1] Cold snaps in winter are

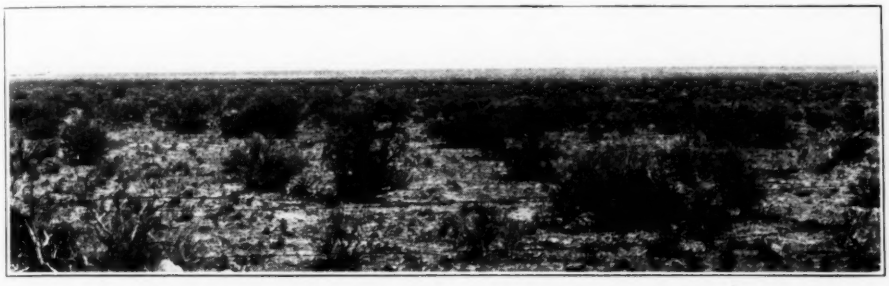

FIG. 2. A broad expanse of desert scrub. Looking south from the highway east of Trinidad. Average rainfall 7.5 inches.

not infrequent, but cold spells of considerable length seldom occur. On only 17 days of the summer does the temperature reach 90° or above, which, with the low relative humidity, results in a very low sensible temperature. Cool nights, typical of the region, are very desirable for human comfort, but act adversely in the production of certain crops, most notably corn.

Unlike temperatures, much variation is found in both seasonal and annual distribution of rainfall, a fact which has largely been responsible for the wide variation of human adjustments within this portion of the Columbia Plateau. Reference to Figures 1 and 4 in connection with the following tables will give an excellent idea of the rainfall and temperature similarities within each district in addition to the contrasts that exist between the different human use regions.

[1] E. M. Keyser, Spokane Weather Summary.

TABLE 1

Mean maximum temperatures of type stations for summer months.

	Waterville	*Odessa*	*Wahluke*	*Colfax*	*Wilbur*
May	66	72	76	67	68
June	74	80	84	74	76
July	83	90	93	83	84
August	83	87	91	84	84

TABLE 2

Rainfall during growth (A, M, J) and harvest period (Aug. S)

April	.78 In.	.64	.33	1.43	.87
May	1.14	1.01	.45	1.73	1.45
June	.83	.74	.43	1.11	.97
August	.5	.32	.41	.56	.55
September	.56	.52	.33	1.01	.63

TABLE 3

Growing Season of each station in days.

125	122	188	111	82

TABLE 4

Regional Differences

	Oases	*Desert*	*Doubtful*	*Reliable*
Average Snowfall		14 in.	21 in.	36 in.
Rainy Days	40	44	60	80–105
Average Crop Failure	0%	75%	35%	10%–0
Size of Farms	5–20 A.	3,000 A.	1,200 A.	500 A.

THE DESERT

This region (Fig. 7), of less than eight inches of rainfall, has remained practically unused by man. In fact, within the entire area of over 1,000,000 acres the population averages only one per square mile. A 1910 topographic map of the area west of the Moses Lake oasis showed twenty homes, two schools, and a country store, evenly distributed along seventeen miles of section line road. In 1930 there were no schools, no store, and only two small houses remaining of the twenty. So completely has the area been repossessed by its former sage brush flora that it is possible to travel many of the rural roads for a distance of thirty miles without seeing a human habitation. The major portion of this region has never been settled and the remainder has declined since attempts at most extensive agriculture have failed.

At least 90 per cent of the population lives in scattered villages on the railroads or thru highways, their income being derived from

the thru traffic, supplemented by the meagre needs of the region itself. The largest community owes its existence to railroad shops. A gasoline and oil station located on the cross-state highway is much more valuable than several thousand acres of this arid land.

In spite of these desert conditions there are occasionally large fields of wheat planted in hope that there will be sufficient precipitation to produce a crop worth harvesting. As a result of extensive agricultural practices a margin of profit will result even with a yield as low as six bushels per acre. This activity is a gambler's chance at best and the odds are all against the farmer. The total export of grains from the desert stations which draw from nearly

FIG. 3. A portion of the Moses Lake oasis district. Desert scrub on slope in foreground with orchards in the background. Note the practically level character of the land below the terrace in foreground.

2,000 square miles is but one-seventh the amount shipped by one station drawing from only 60 square miles in the reliable zone.

The raising of beef cattle occupies a very minor place in the activities of the area, only one-sixth of the farmers being engaged in this pursuit. Deficiency in pasture lands and in areas capable of producing hay have made this region unattractive to stockmen interested in the production of beef. Only in the shallow coulees is there sufficient natural pasture for the cattle to eke out a meagre existence during the long, dry summer. It is here that the seepage of the intermittent streams maintains the only semblance of natural green growth after the spring showers.

Sheep raising, tho more important than cattle raising, is relatively unimportant when compared with similar areas of Idaho and Wyoming. Lack of local production of hay for winter feeding

and the distance to summer pastures in the mountains have combined to limit this industry. The great importance of local hay production and climate in the sheep raising industry of Eastern Washington is made evident by the fact that Franklin County with its irrigated alfalfa lands, and with its relatively open winters which result in a very short period of "feeding," leads the other five counties in the number of sheep.

Upland Oases

Standing out in sharp contrast to the arid sage brush plains are the small irrigated areas located on lakes (Fig. 3) or where water is available from deep wells. Within the past five years Neppel, the community center of the Moses Lake district, the largest oasis, has grown rapidly. In fact it is the only town in Grant County that has shown a marked increase in population. The success of orchards, upon which the community bases its existence is made possible by the water of the lake which is elevated by pumps to the orchards occupying the low terraces immediately adjacent to the lake (Fig. 3). In the orchards most remote from the lake, wells supply the water.

The area is also blessed with abundant sunshine, long frost-free period and gravelly loam soil, all of which combine to make it especially adapted to fruit raising or truck farming. Apples, pears and peaches are the major products, tho the last few years have witnessed an increasing acreage of alfalfa and vegetables, notably melons and potatoes.

In spite of this rapid expansion of the oasis to its present size, its extent will necessarily be limited until other sources of water are available. The climate again enters in, since, altho the lake has a large tributary area, the stream feeding it is intermittent because of light winter snowfall (Table 4) and summer aridity. The possibilities of the district, however, are unlimited were water available.

River Terraces

The Spokane Valley District

The Spokane Valley district, located immediately east of that city, is the largest of the many widely separated irrigated sections of the periphery. The shallow channel and the relatively rapid descent of the Spokane River makes irrigation by gravity easy and very inexpensive. In spite of this, the wide fluctuation in its

flow has resulted in the hydroelectric power interests limiting its use for irrigation. The control of climate is again noted since the low water period is the period of greatest need of water in the fruit raising and truck farming industries. Altho demands for electric power for Spokane and the cities of the surrounding coun-

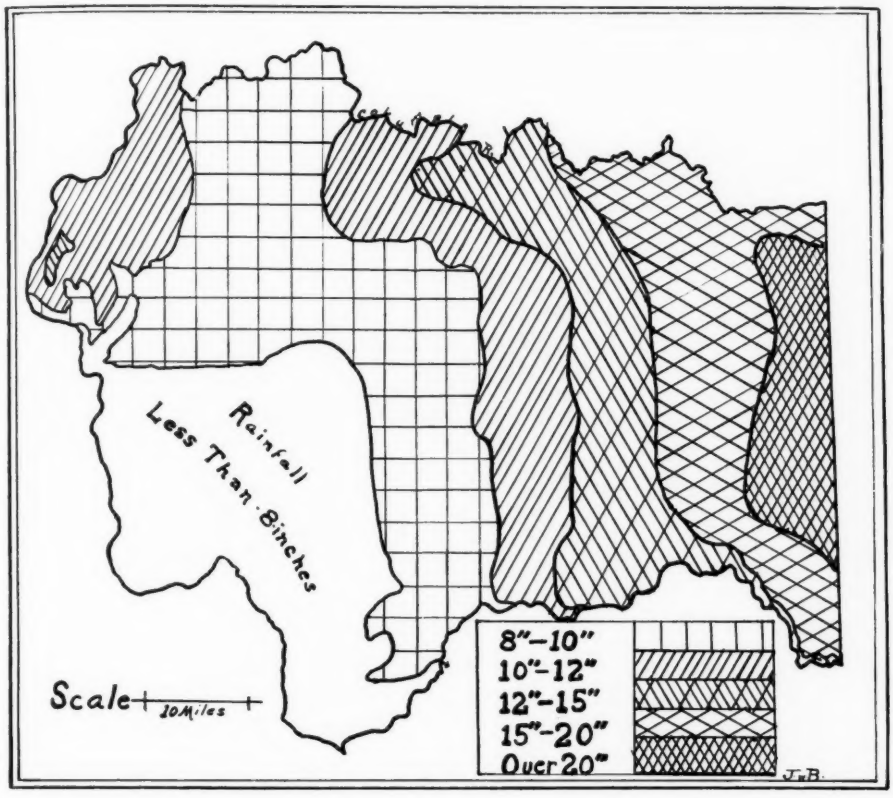

FIG. 4. Rainfall map. Especially notable is the regular increase in precipitation from the desert area to the eastern border. Note the much heavier rainfall in the Waterville area (Fig. 1).

try necessarily limit the water available for irrigation, the cities provide an excellent market for products of the valley.

The three lakes located on the margins of the valley owe their existence to melting snows. Since any extensive use of water from them results in a marked lowering of their summer level irrigation from them has met with little success. The lakes are valuable recreational centers and any reduction of their level is met with vigorous protests by the owners of lake-shore resort property.

Excellent wheat and barley crops are grown without irrigation on the upper portions of the valley as well as on those most difficult to irrigate. The orchards and truck gardens of the irrigated areas contrast sharply with the grain fields which depend upon precipitation alone for moisture supply. This is the only region classified as an irrigated district which has sufficient rainfall to make such agriculture possible. It is also very important to note that the valley has a growing season of 175 days as contrasted with a frost-free period of less than 100 days (Table 3) on the plateau immediately to the southwest or west. Thus we have, largely as a result of climatic controls, within this relatively small area, extensive and intensive cultivation carried on successfully side by side.

Peripheral Tracts of the Southern and Western Margins

Within the steep-sided canyons of the lower Spokane, the Columbia, and Snake Rivers, there are numerous alluvial terraces or fans, the majority of which are utilized for the production of fruit and vegetables (Fig. 7). The water is obtained by pumping from the main streams or by gravity flow from the numerous intermittent streams from the uplands.

The low elevation results in an early spring and a growing season of nearly 200 days (Table 3). The terraces of the upper Columbia are used exclusively for the production of fruits, especially apples. The Pasco and Snake River areas, with an earlier spring and better transportation connections with the major upland farming regions and Spokane, are noted for their early vegetables and melons. While the Douglass County fruit raising acreage is rapidly increasing, the orchards of the Pasco territory are being reduced to make possible larger tracts devoted to vegetable growing. There is a much heavier snowfall in the apple growing section. Moreover, the proximity of snow-covered peaks tends to check early blossoming, thus reducing loss by spring frosts to a minimum.

Semi-arid conditions coupled with late spring frosts and more severe winters, make it practically impossible for the farmer of the upland districts to rely upon a home orchard for peaches, cherries, or apricots, or on his garden for early produce (Fig. 5). The orchardists of the irrigated periphery, most notably those of the Snake River sections, have capitalized upon this effect of climate. The numerous trading centers of the wheat belt afford an excellent market. In addition to this the extensive road programs

and the use of trucks have placed the gardener and orchardist of the valley within two hours of them. Whereas a few years ago the Pasco locality raised few vegetables for export, in 1929 it shipped 55 carlots of melons, 120 of lettuce, 33 of onions and 17 of potatoes. The success of peach raising on the small terraces and fans along the Snake River is illustrated by the fact that the production of these extremely restricted areas is sufficient to place Whitman County second in the entire state in peach production.

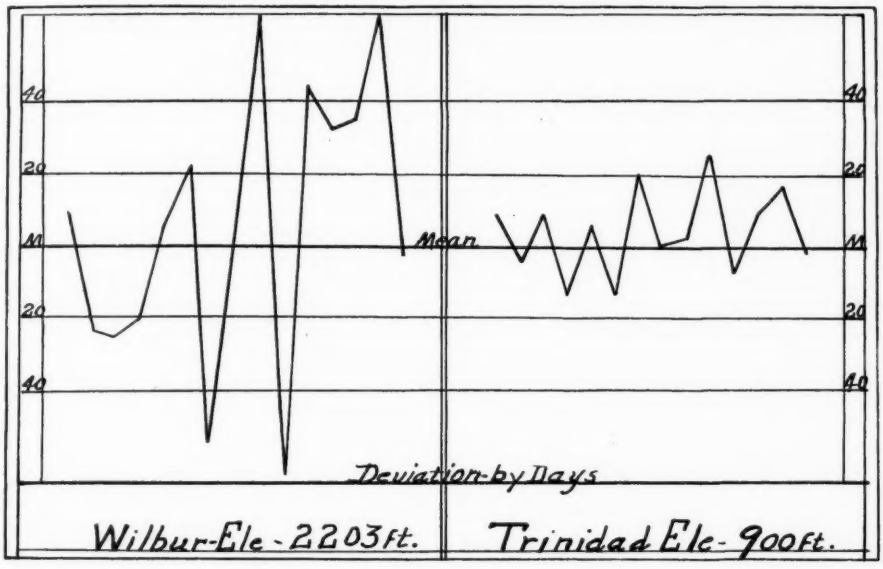

FIG. 5. The story of success or failure in fruit and vegetables on the uplands and along the Columbia. Note the great deviation and unreliability of Wilbur. Record for 15 years.

THE MARGINAL WHEAT BELT

Lying between the desert and the Reliable Zone is a broad belt of transition with about eight to twelve inches of rainfall. It is here that farms of 800 to 1,600 acres hold sway (Chart 4). The great fluctuations in rainfall and the relatively small annual precipitation make large farm units necessary. Thus it has been termed the area of "big crop or no crop" since, with the large acreages, the years of sufficient rainfall with their bumper crops more than offset the poor years that may follow. Only the more favorably located intercoulee uplands are cultivated, the remaining acreage being used for early spring pasture.

The true transition character of this region becomes evident

to the traveler who crosses from the desert, in an east-west direction, to the rolling Palouse hills. The elevation increases gradually and with this increase of elevation the rainfall mounts progressively from eight to twelve inches. The sage brush thins out and bunch grass replaces it in the uncultivated areas. Trees, totally absent from the desert, begin to appear along the dry washes, the channels of the seasonal drainage system of the semi-arid area. As the eastern border is approached cultivated fields become the rule rather than the exception, while the more closely spaced farmsteads, characterized by modern buildings and sheltered by a cluster of trees, indicate the prosperity of the wheat farmer within the zone of sufficient rainfall.

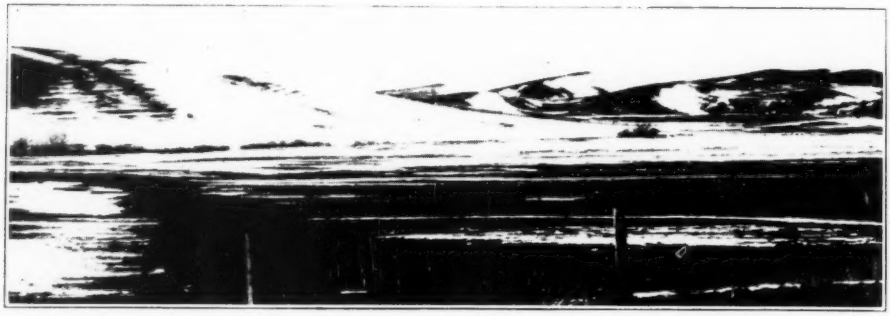

FIG. 6. Typical Palouse hills and snowbanks. Note especially the gradual south slopes and snow-covered north sides of the hills in the center of the view.

During the past summer the writer crossed the area just as the winter wheat was beginning to head. Near Ritzville, which averages eleven inches of rainfall, the grain was from twelve to sixteen inches in height while only ten miles to the westward the grain was already withering as it was heading at eight inches. Still farther west the wheat crop was already practically "cooked," a result of light snowfall and lack of sufficient spring rain. A second trip thru the area and interviews with the farmers after the harvest season, revealed that the Ritzville district had averaged twenty bushels per acre while only twenty miles to the westward, near the desert margin, the crops had been a total loss.

Oats, or other cereal crops, are not grown to any extent, moreover the dominance of large scale wheat farming has resulted in the relegation of stock raising to a minor place. Cattle are not important in any portion of the Doubtful Belt, while sheep are raised only in the north coulee areas of Grant County and in a few iso-

lated "rough" sections of Adams County. In the latter instance the sheep are driven to the mountain foothills to the east for summer pasture.

THE RELIABLE WHEAT BELT

Fall and spring showers, coupled with heavy winter snowfall, (Tables 2 and 4) combine to make this area one of the highest per acre producing non-irrigated wheat regions in the world. The reliability of crop production is perhaps best shown by the excellent highway system (Fig. 1), prosperous appearing farmsteads, and the large bank clearings of the district. Land values thruout the Reliable Zone are two to three times those of the counties to the west. High productivity is also evidenced by the much smaller farms, altho agriculture remains on an extensive wheat production basis (Table 4).

The Waterville tableland, located in the northwest corner of the Plateau, has but eleven inches of rainfall. Nevertheless, this territory is favored with lower summer temperatures and a resulting lower rate of evaporation, hence it is a reliable wheat growing district altho bordered by desert within twenty miles on the south and by the irrigated terraces of the Columbia on the west and north.

The rolling loess hills of the Palouse present a picture entirely different from that of the relatively level plains to the west. The gentle south slope and steep north sides of these hills show the result of the prevailing southwest winds (Fig. 6).

There is a tendency for the snow to drift (Fig. 6) on the north sides leaving the gentle south slopes relatively bare. This fact, coupled with lower evaporation on the north sides, naturally results in difficulty of early spring cultivation, moreover, the steep slope and the extreme moisture conditions tend to cause the north sides to wash considerably. There is also the possibility of the wheat freezing out on the south slopes or bare ridges, or else smothering under the slowly melting snowbanks. In fact, it is not uncommon to see a Palouse farmer, in late spring after the south slopes are dry, plowing his snowdrifts so that they will melt more rapidly.

In spite of these problems, the lower evaporation rate and the greater moisture content results in as good crops on these slopes as on those facing south or southwest. During the past few years the combined harvester (Fig. 8), since it is well suited to the ex-

tensive agricultural practices, has largely supplanted the old bind-shock-thresh combination. Nevertheless, uneven ripening of the grain presents another problem. This difficulty does not arise in the plains areas, or more level fields of the Big Bend country.

These problems arising from features of the climate are offset

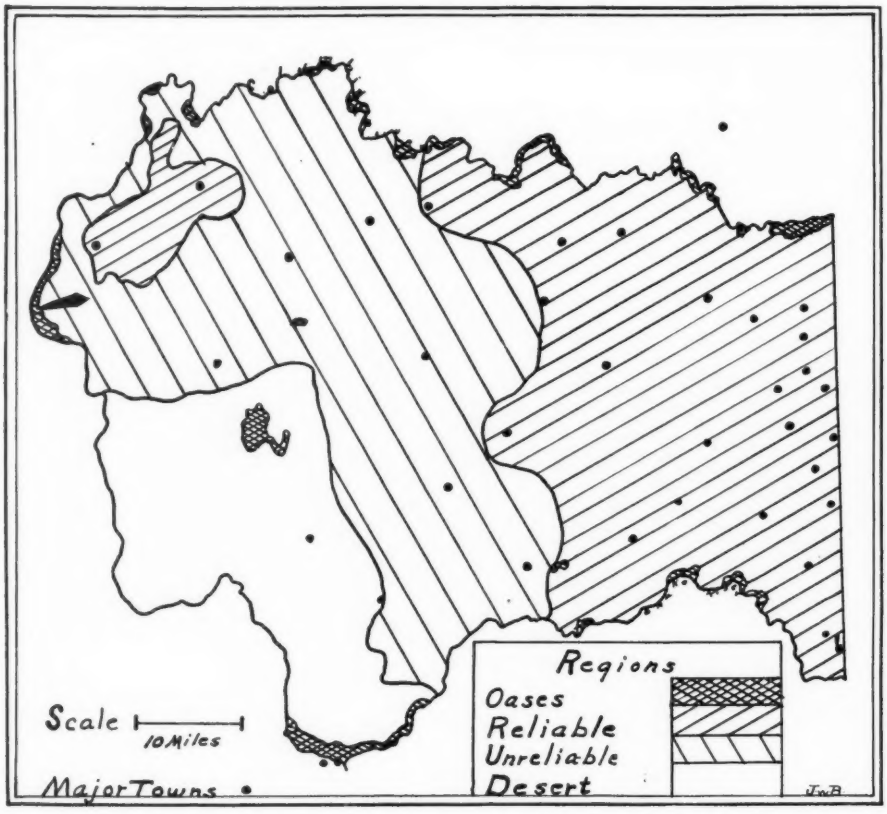

FIG. 7. Regions of the area based on types of adjustment of man. Compare with the rainfall map.

by a relatively dry summer (Table 4) which results in the grain curing while standing, thus making the combined harvester method of harvesting possible. It must also be noted that the harvest season experiences very little rain.

MOISTURE CONSERVATION PRACTICES

Summer fallowing is characteristic of this region as well as of the drier central and western portions of the plateau. This practice of leaving a portion of the land lie idle alternate summers is neces-

sary since there is practically no summer precipitation. There must therefore, be a rest and storage period. In short, it takes two years of precipitation to produce one crop in the transition zone while in the major wheat area only one-third of the land lies idle while the other two-thirds are in crop. Since the portion lying idle is cultivated at intervals thru the summer, the practice of summer fallowing acts as an excellent check on the spread of weeds, or use of moisture by them. While the lack of precipitation necessitates such a system, it has, on the other hand, kept soil erosion to a minimum.

FIG. 8. Use of modern combined-harvesters in the Palouse region. Note the heavy stubble and height of the grain.

PURSUITS OTHER THAN WHEAT GROWING

As a result of the sufficient moisture enjoyed by this region, there has for many years been a tendency toward diversity of crops altho wheat has maintained its outstanding position. Wheat is the major cash crop while oats and barley are grown mainly for feed purposes. Altho oat and alfalfa hay are fed to dairy cattle the major hay crop consists of wheat. In fact, the acreage of wheat cut for hay exceeds the entire oat and barley acreage planted. The major portion of this wheat hay, which is fed to horses or mules, comes from the practice of cutting wide roadways around the fields and in the "coves" to permit use of large machinery without destroying the grain while cutting the first two swaths. The wheat hay is cut two to four weeks before the grain is ripe enough to harvest.

The acreage of annual leguminous crops, peas and beans, has

increased rapidly in recent years. They are grown near the mountains on portions of the farms that would otherwise be summer fallowed. As a result of heavier rainfall in this part of the area the farmer can raise nearly as good a wheat crop each year by rotating. Not only is there the return from the crop of peas or beans, but the labor that would be expended on the summer fallow more than offsets the planting of the peas.

The peas of this region have very high germinative qualities, a direct result of the climate. That portion of the crop that is not taken by eastern concerns for seed has found a ready sale as split peas. Most of the eastern peas have to be kiln dried before they can be split, while in this climate with dry summers, the ripe peas, comparatively free from moisture, are ready to be immediately run thru the machines.[2]

Another excellent possibility in way of diversification is that of livestock raising. In the Inland Empire sweet clover will carry two, and even more, mature Shorthorn cattle on one acre not merely during the spring and fall seasons, but on thru the summer months.[3] The variety of crops that can be produced, coupled with a climate that requires a much shorter feeding period during the winter than the Wisconsin dairy region, further substantiate the fact of the great possibilities in either dairying and hog raising or the production of beef cattle in this Reliable Zone.

The Outlook and Conclusions

Altho several soil scientists and crop experts believe a system of dry farming agriculture could be worked out that would be successful in the present desert areas it seems that the only hope of wide extension of the acreage of reliable production lies in the development of irrigation. Increase in production of the reliable belt can only result from a definite program of diversification of crops and the expansion of the livestock industry.

From the Columbia on the west to the mountains on the east the soils of the tillable areas are ideal for agriculture. Thruout the entire area discussed the relief is such that over 85 per cent of the land may be easily cultivated. The success of man in the scattered

[2] A Survey of the Pea Growing Industry of the Inland Empire, Spokane & Eastern Trust Company, 1930.

[3] Dr. W. J. Spillman, Consulting Specialist of Bureau of Agricultural Economics.

irrigated districts and in the reliable non-irrigated regions further emphasize the fact that climate, practically to the exclusion of all other elements of the environment, is the controlling factor of man's activities in the Columbia Plateau.

SOVIETIZING AGRICULTURE

I. MORELAND HOPKINS

Saint Lukes College
Exeter, England

THE BACKGROUND

Agriculture provides the foundation of the economic system of the Soviet Union and its progress can be regarded as a gauge of domestic prosperity. In order to appreciate fully the situation in the Union of Socialist Soviet Republics, we must study agricultural development in Russia from the beginning of the twentieth century. From 1906 there is a decided improvement both in methods of cultivation and in production, until the bad harvest of 1911-12. The modernization of agriculture was reflected in the increased importations of agricultural machinery and in the rise of the exports of agricultural products.

Importations of Agricultural Machinery

1906 .....imports valued at $20,618,560
1913 .....imports valued at $67,010,320

Export of Agricultural Productions

1905 .....exports valued at $488,144,408
1913 .....exports valued at $773,196,500

Use of Fertilizers

1907 .....349,206 tons were used
1913 .....982,700 tons were used

(These figures are exclusive of the extensive use of local manures.)

It is evident from a study of the crops produced that the foreign market was the strongest incentive to agricultural development. The following table shows the ratio of the area under the chief cereals to the total area under cereals, and the ratio of the chief cereals to the crop of all the cereals.

Wheat, the export crop, shows a gradual rise in relative importance, over rye, the domestic crop. Thus with the active concen-

tration on the growing of wheat we have a rapid rise in the export of cereals.

	Area		*Crop*	
	Wheat	*Rye*	*Wheat*	*Rye*
1896–1900	23.8	35.2	21.2	37.9
1901–1905	26.1	33.5	25.3	34.2
1908–1910	27.9	31.1	26.2	30.7
1911–1913	29.8	30.2	24.2	32.2

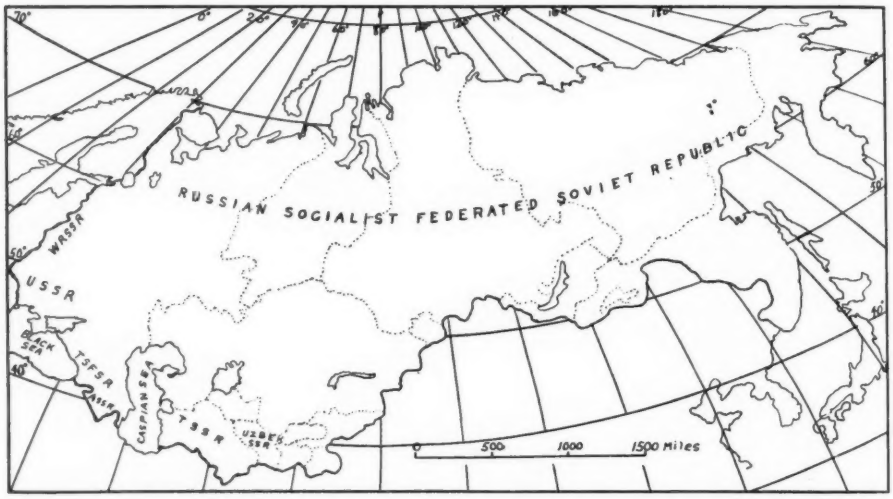

FIG. 1. The Union of Socialist Soviet Republics in 1925. R.S.F.S.R.—Russian Socialist Federal Soviet Republic—contains 10 autonomous Republics and 13 autonomous regions. T.S.F.S.R.—Transcaucasian Socialist Federal Soviet Republic—includes the Socialist Soviet Republics of Azerbaijan, Armenia and Georgia, and also contains 2 autonomous regions and united with Georgia is the Independent Soviet Republic of Abkhazia. U.S.S.R.—Ukraine Socialist Soviet Republic. W.R.S.S.R.—White Russian Socialist Soviet Republic. T.S.S.R.—Turkmenistan Socialist Soviet Republic. Uzbek. S.S.R.—Uzbekistan Socialist Soviet Republic.

Cereal Exports

	Tons
1907– 8	6,522,300
1908– 9	8,768,100
1909–10	13,267,450
1910–11	15,212,800
1911–12	8,650,900
1912–13	14,192,100

In comparing Table 4 with Table 5 it will be noticed that the export year 1911-12 shows a decided drop from 1910-11, due to a

bad harvest, and that in 1911-13 the ratio of rye to the total crop, contrary to previous years, rises, while the ratio of wheat to the total crop drops. Thus the bad harvest had the most powerful effect on the wheat crop and this in turn caused a drop of 6,570,000 tons in the total export of cereals.

This active development of agriculture reacted on the milling industry, and in 1912 it was more widespread than any other branch of manufacturing. The increased home consumption, due to the increased purchasing power of the people, and the improvement of railway transport also aided the growth of this industry. At first

Freights from the Flour Mills Carried by the Railways (Tons)

	1908	1909	1910	1911	1912
Wheat Flour	2,322,000	2,472,000	2,648,000	2,854,600	3,048,000
Rye Flour	1,174,500	1,291,800	1,218,900	1,201,400	1,271,200
Bran	694,200	783,000	770,300	1,009,600	1,042,900
Totals	4,190,700	4,546,800	4,637,300	5,065,600	5,362,100

Export of Flour (Tons)

	1910	1911	1912	1913
Wheat Flour	107,780	117,290	101,440	129,970
Rye Flour	87,175	150,575	95,100	109,365
Totals	194,955	267,865	196,540	239,335

it was concerned only with the home-markets, but as the number of small mills engaged in a purely local sale increased, the bigger mills began to look abroad.

On a closer examination of the exports of agricultural produce it is noticeable that the intensity of exports decreases from south to north and from west to east. Regional adaptability to large scale cereal production and proximity to the world's markets are the decisive factors governing this distribution.

Regional Export of Agricultural Produce

	Per Cent of Total
Southern Area	60
Western Area	20
Middle and Lower Volga	17.1
Central and North Area	2.9

The leaders of the Soviet Union realized that the progress made by agriculture would constitute one of the most important factors in the general welfare of the country but the situation had become fraught with much more possibilities and greater difficulties as the peasants were now in possession of the private and public estates. Due to a lack of proper supervision and chicanery in the allocation of the land and in the division of the stock, some peasants had none and others had more than they could work. The result was chaos and a failure of the total crop. In 1916 in 49 provinces there were 15,645,508 peasant holdings and 110,157 private holdings. The peasants planted 64,022,333 acres and the large owners 7,687,361 acres which gives an average of 4 acres per peasant holding and 69.7 per private holding. The result of the primitive methods adopted by the peasant as opposed to the private estate owner is seen in the following table:

Yield in Cwts. per acre on the Peasant and Private Holdings

1916 average harvest of Rye from peasant holding was 17.8 cwts. per acre
1916 average harvest of Rye from private holding was 22.95 cwts. per acre
1916 average harvest of Wheat from peasant holding was 11.75 cwts. per acre
1916 average harvest of Wheat from private holding was 21.3 cwts. per acre

THE NEW ERA

The Revolution caused a complete dislocation of the old agricultural policy. The attitude of the peasantry towards the new régime was charged with uncertainty. Tenure of the land changed from day to day. One might sow but who would reap? This question was answered by only producing a self-sufficiency. Then came the bad harvest of 1918. The state organs of distribution required 4,122,585 tons of grain as a minimum but could only collect 1,772,900 tons. Even the peasants were starving. The position was aggravated by the successes of the Counter-Revolution in the grain districts of Siberia and South Russia. In February 1919 only 1,172,900 tons were available for collection and the land under cultivation declined to five-sixths of the area of 1917. The decrease in the cropping area was felt most heavily on wheat and lightest on rye. As rye formed a large part of the diet of the peasant the area under this crop was, in 1919, only 7.5 per cent less than in 1917, while over the same period the area under wheat decreased by 20 per cent.

With the defeat of Denikin and Kolchak and the stabilization

of the Soviet Union as a domestic power, the outlook of the peasants became brighter. This brought about an improvement in the food situation for in 1920 the grain supply, exclusive of Siberia, amounted to 1,711,800 tons. The peasants realized that there was now some opportunity of exchanging surplus grain for manufactured goods, and made an effort to increase production. Here again reconstruction met with a check, for due to the blockade and the poor home output, there was very little available agricultural machinery. In "Economic Life" No. 255 it was stated that the manu-

Fig. 2. Primitive type of agricultural implement still in common use.

facture of agricultural machinery, within the Soviet Union, for the nine months from October, 1919 to July, 1920, was as follows:

2,471 reaping machines
683 mowing machines } Demands were made for 36,000 machines.

1 sowing machine .... } Demands for 32,00 machines.
24,127 plows ..... } Demands for 687,000 plows.

It should therefore be evident that even under powerful local stimulus, development must of necessity be slow.

With the raising of the blockade there was a slight amelioration of the critical situation caused by the scarcity of machinery, but the conditions improved slowly. In order to fully understand the remarkable fluctuation in the imports of agricultural machinery we will cite the case of Canada. In pre-war days, Canada sent agricultural machinery at the rate of $1,804,124 per annum, but suspended all exportations until 1924. During that break there would be a decided deterioration in the machine equipment of the farm lands.

In order of value of imports the United States stands an easy first with Austria a poor second. Regarding the imports from the United States, it is interesting to note that in March, 1926, Mr. Henry Ford broke his established rule, to sell only for cash, by supplying 10,000 tractors on part credit terms to the Soviet Union.

Total Imports of Agricultural Machinery

1924-25 (Oct. 1924-June 1925)	$10,515,466
1925-26 (Oct. 1925-June 1926)	22,938,148

Imports of Agricultural Machinery from United States

1923-24	$1,115,000
1924-25	8,000,000
1925-26	8,415,868

Imports of Agricultural Machinery from Austria

1923-24	$1,240,360
1924-25	3,247,423

The estimated requirements for 1926-27 were computed at the sum of $67,000,000 which would mean that import figures would still keep high. The equipment purchased would be absorbed in the following manner:

R.S.F.S.R.	takes	66.0	per cent	of	the total
Ukraine	takes	26.5	per cent	of	the total
Caucasia	takes	2.8	per cent	of	the total
White Russia	takes	2.5	per cent	of	the total
Uzbekistan	takes	1.7	per cent	of	the total
Turkmenistan	takes	.5	per cent	of	the total

It was realized that the feeling of the exporting countries was one of uncertainty and that there would therefore be no security of importations on which the Soviet Union could rely. This difficulty was countered by the steady increase of the home output of agricultural machinery. In 1925-26 over 40 per cent of the required machinery was imported but in 1926-27 the figure was 23 per cent and in 1927-28 it had been decreased to 20 per cent. The stabilization of agricultural output was becoming more and more a purely domestic concern.

When considering the above figures we should also bear in mind the change in the relationship between the area under grain and that under pasture. The steady decline in the acreage of pasture land and the increase in the acreage of the grain producing areas was the first outstanding result to demonstrate the soundness of this move by the government. The area under pasture in 1925 was 71.5 per cent of that of 1924, while the area under pasture in 1926

was 92.1 per cent of that in 1925. When we examine the grain figures we see that the 1925 area was 7 per cent over the 1924 area while the 1926 area was 5 per cent over the 1925 area. The fact that the total area under cultivation in 1926 was 88.3 per cent of the 1913 acreage gives a very clear idea of the real progress that had been made. When we compare agriculture with industry we find that development has been slow. This is what we should expect when we remember that the peasant was the market for industry and that he was being induced, not forced, to increase his output.

FIG. 3. Primitive type of agricultural implement still in common use.

The wonderful growth of industry will be more fully appreciated if we bear in mind that the average increase in industrial output before the Great War in Russia was only 5 per cent.

An essential fact in this slow development of agriculture was the need for the investment of new capital. In countries where we find a highly developed agriculture, where land is being rationally utilized and scientifically cultivated, as, for example, in the United States, more than four times as much capital is invested for each worker as in the Soviet Union. Because of this need for capital the Council of the People's Commissaries issued in November 1920 their concession policy, which stated that the progress of restoration of the productivity of the country and the world's economy could be accelerated greatly by the collaboration of foreign capital

for the utilization of the natural resources of the U.S.S.R. It was laid down that the capital invested could neither be nationalized, confiscated, nor requisitioned. A later article established that no changes could be made in the concessionary agreement or could be introduced without the consent of both parties. On this security we find a gradual increase in the capital invested in agriculture, from $332,732,012 in 1923-24 to $498,144,410 in 1926-27.

The main ideas behind the granting of concessions were the undertaking of reclamation work requiring large expenditure of capital and in the educational value of the demonstration to the peasants of the value of up-to-date intensive methods of cultivation.

Side by side with the extension of concessions the Soviet Union have reconsidered and altered their agricultural policy as a whole,

Ratio of the Development in Agriculture and Industry
(Output of 1923–24 to represent 100%)

	1924–25	1925–26	1926–27
Agricultural Commodities	117.2	139.8	150.9
Industrial Commodities	173.8	236.1	270.3

In the special instance of the Black Soil area we find three new provisions embodied in the 1926-27 program of the Council of People's Commissaries of the R.S.F.S.R. The most important was that dealing with the redistribution of the land. Under the then prevailing system of land distribution the area was divided into too many separate holdings controlled by large villages. It was recorded that 70 per cent of the villages of the region had over 100 holdings. The scheme aimed at smaller villages and larger holdings. By a resettlement of the population the cultivator was given readier access to his land which would result in an all-round improvement in methods of cultivation and in production. The other two provisions embodied the organization of the markets, the installation of a set crop rotation system and the improvement of the livestock.

This move by the Soviet Union should not be regarded as having any outstanding political significance, but was merely an expedient to overcome an economic situation of considerable difficulty. It will be noticed that right from the beginning of reconstruction the policy of the Soviets has been directed in favor of the peasants who

receive an ever increasing measure of State assistance and contribute less and less in taxes. This throws an additional burden on the urban population.

Ratio of Direct Taxation to Income for 1924–25

	Income per head	Taxes per head	Per cent of Taxes to Income
Peasant	$ 50	$ 2	4
Town Population	$144	$16	10.8

The peasants realized that the State was behind them and this confidence was reflected in their output.

	Area (In million acres)			*Average Harvest (In million tons)*		
Crop	1913	1924	1925	1911–15	1924	1925
Rye	70	65.9	67.5	19.8	16.8	19.2
Winter Wheat	14.9	14.0	16.5	17.35	10.1	15.8
Summer Wheat	63.5	31.2	35.0			
Barley	45.0	16.7	14.5	12.4	3.7	5.6
Oats	28.0	28.9	28.6	8.2	7.2	9.5
Maize	2.4	5.1	7.6	1.07	2.3	4.3
TOTALS	223.8	161.8	169.7	58.82	40.1	55.4

The influence of more intensive methods is seen in the decrease in area of the barley and oats culture and the increase in the yields. Over all crops this same tendency may be noticed for with 80.2 per cent of the pre-war area under cultivation in 1925, it is recorded that the yield was 94.1 per cent of the pre-war harvest. Another point of interest is that while the harvest was 94.1 per cent of the pre-war figure the grain exports were only 14 per cent of the pre-war exports. This may be explained by the fact that only in 1925 was it possible for the grain reserves of the country to be built up after the difficult years of 1920-24 when the reserves were cut down to only 3 per cent of the total harvest instead of the 15 per cent of the normal pre-war years. We must also remember that the harvest of 1924-25 was seriously interrupted by bad weather which ruined the yield in many areas. In order that the country should suffer as little as possible from this setback, the State would not permit usual exports until the home market had been supplied. This line of action will mean that the export figures will fluctuate,

under influence of the harvest, more markedly than ever before as shown by the following exports of grain in tons: 1922-23, 584,865; 1923-24, 2,612,000; 1924-25, 380,400; 1925-26, 1,981,250; 1926-27, 3,177,925.

FINANCIAL AIDS

In order to help on this effort to re-establish agriculture, the Central Agricultural Bank was founded in 1924 and is now a very important factor in the credit system of the Soviet Union. Even before the Great War, Russia was poor in capital equipment and the State experienced great difficulty in meeting the demands of the peasants for financial aid. In 1926 the Bank had at its disposal, $193,299,000 for the financing of agriculture, and had caused

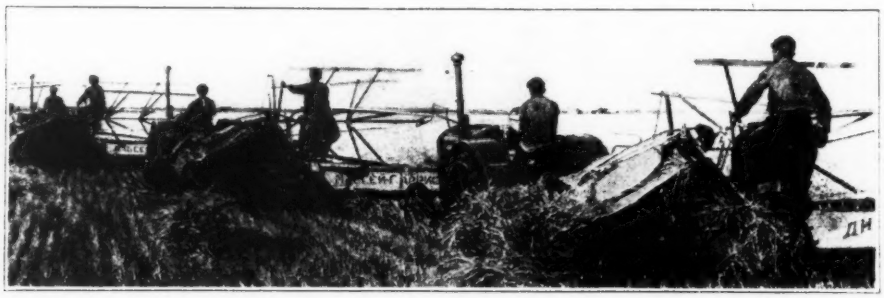

FIG. 4. Modern machinery on the "Benardaki" soviet farm.

an all-around lowering of interest on credit given to the peasants. Nine-tenths of this available capital had been advanced by the State.

In 1924 the interest charged on credit was anything from 16 to 33 per cent, but in 1926, due to the operations of the Central Agricultural Bank, the rate dropped to 6 to 10 per cent. This meant a decided rise in the purchasing power of the peasant.

Another practical measure which has been adopted to consolidate agricultural economy is State Insurance. The aim of this scheme is to accord immediate help to peasant households in bad times. In this comparatively primitive land, fire, hail, drought, cattle-diseases are the age-long scourges of the peasant people. The State now offers compensation. In 1924 the Insurance Department spent $773,196 in preventive measures and in 1925 this figure was increased three-fold. This new movement was very popular with the peasants and we find that in 1926 insurance covered, 90 per cent of all peasant buildings against fire, 78 per cent of all areas under cultivation against inclement weather, 84 per cent

of all big horned cattle against disease, and 75 per cent of all horses against disease. The rate of State Insurance is 76 cents per $100.

CONCLUSION

In concluding this paper on the development of agriculture under the Soviet Union, mention must be made of the work of the Coöperative Societies. The work performed by the different societies varies considerably on account of the great variety of conditions prevailing in the different agricultural districts of the U.S.S.R. This movement is not recent but had its inception in the

FIG. 5. Peasants awaiting the ferry in central R.S.F.S.R.

"mir" or village community in which the peasants are associated together for the joint utilization of the village holding. Later on, the influence of the coöperative movement in other countries brought about the formation of societies on the English model. They started about the year 1860 but due to the suspicion with which they were regarded by the Imperial Government and the police, progress was very slow. The societies improved their position from year to year until we find that during the Great War, the Revolution and the Civil War, the coöperative system was the only organization for trading purposes which managed to keep going and survive that difficult period. Now they have the backing of the State and their powers have increased with an increased turnover.

New forces have been at work in order to build up a new Russia

Turnover of the Moscow Goods Exchange

	Total Turnover	Purchases in Percentages			
		State Organs	Co-op	Mixed Co-op	Others
1924–25	$1,542,269,288	65.9	25.4	1.6	7.1
Jan.-March (1926)	$ 357,722,016	59.2	32.9	1.8	6.1
Apr.-June	$ 408,762,952	46.6	45.6	2.0	5.8

and we should be thankful that we are privileged to witness so interesting an experiment.

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THE TIDES: TEACHING THE ESSENTIAL FACTS

SAM T. BRATTON
University of Missouri

Many teachers of geography, for one reason or another, feel duty bound to explain the "causes of the tides." It is hoped that such explanations are made as simple as possible and well within the understanding of the average student group. The following suggestions may be helpful.

For various reasons many students have some incorrect ideas about the relations of the earth and moon and consequently about the tides, hence in order clearly to understand the essential facts it is necessary to correct such false impressions.

One must quite clearly understand that the moon *does not* revolve, or go, around the earth from east to west each twenty-four hours, or thereabouts, altho its appearance in the east, passage across the sky, and disappearance in the west, gives one that impression. This apparent motion of the moon is due simply to the rotation of the earth from west to east in about twenty-four hours. One must understand, also, that the tides are not drawn westward by the moon in its apparent motion from east to west altho they seem to move westward across the oceans.

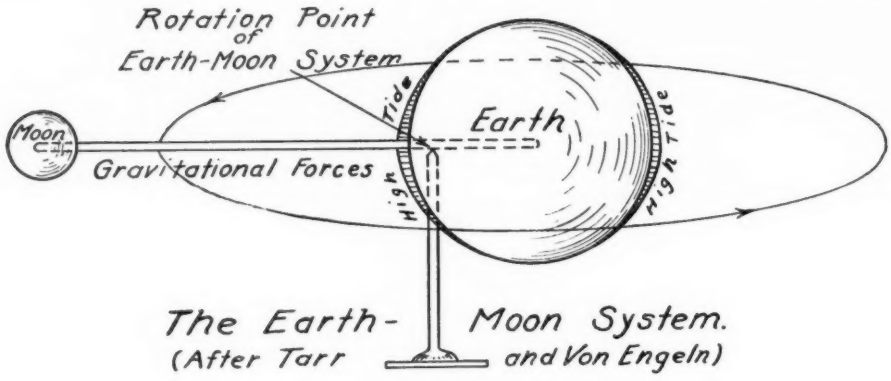
Due to laws of gravitation the earth and moon together constitute a single system, or unit of mass. In this system the earth and moon are held strongly in position with reference to each other. As a single system, or unit of mass, they rotate about an axis passing thru the center of gravity, or center of mass, of the unit system. This center of mass is about one thousand miles within the earth on the side of the earth toward the moon. As the *earth* rotates on its own axis this center of mass maintains its relative position in the earth-moon system. One rotation of the earth-moon system about the center of mass requires approximately twenty-eight days[1] (See diagram).

Forces arising because of (1) rotation of the system and, (2) gravitation in the system, produce a bulge, or tide, on the side of

[1] For the purposes of this discussion it is assumed that the plane of rotation of the earth-moon system coincides with the plane of the earth's equator. Such, however, is not the case. For extended mathematical discussions see the following: Tarr and von Engeln: New Physical Geography. Appendix E;—Johnson, Willis E.: Mathematical Geography; Ency, Britt: "Tides."

the earth toward the moon, and also a bulge, or tide, on the side of the earth opposite the moon.[2] As the earth-moon system rotates the tides maintain their respective stationary positions, and hence *do not move around the earth.* Hence, in the earth-moon system there is, *at all times,* one tide on the moon side of the earth and one tide on the opposite side of the earth, and there they remain.[3]

Now, if the earth did not rotate independently of the earth-moon system these tides would never move across the seas and there would be no tidal rise nor fall of the ocean waters at any place, in fact there would be no moving tides. But the earth does rotate, eastward, hence its land surfaces actually are moved, or turned, into and out of the tidal "bulges" of water. This eastward moving,



The Earth-Moon System.
(After Tarr and Von Engeln)

or turning, of the earth's lands into and out of the tides produces an apparent westward movement of the tidal waters.

Let us illustrate coastal rising and falling of the tides by assuming ourselves stationed on a small island in the midst of the ocean. Remember, there are two high tides on the earth at the same time and that they are stationary, do not move, in so far as the earth-moon system is concerned. Also, that between the high tides are low tides. Now, as the earth makes one rotation on its axis our island will be moved into and out of the high tide on the moonside of the earth, thence on around and into and out of the

[2] "waters on the side of the earth toward the moon are lifted up because there the gravitation force exceeds the balanced average at the center of the earth"—

"On the far side, (of the earth) the gravitation attraction being less than the average at the center of the earth an unbalanced excess of centrifugal force tends to throw off, or heaps up, the water there." Tarr and von Engeln: loc. cit., pp. 633, 634.

[3] Disregarding the "lag" of the tides, and the effects of land masses and water depths.

high tide on the side opposite, or away, from the moon, hence we have experienced two high tides and two low tides during one rotation of the earth, or in about twenty-four hours.

The appearance of high tide at a given place at intervals of approximately twelve hours and twenty-six minutes is due to the fact that as the earth rotates eastward the earth-moon system also is rotating in the same direction, hence the earth-moon tide has moved slightly eastward and the given place must be carried by the earth's rotation slightly farther eastward in order to overtake the tide. The time required for this overtake is about twenty-six minutes.

As suggested above an explanation of the major facts concerning the "causes of the tides" does not present difficulties beyond the understanding of an average high school student. The salient truths to be impressed are, (1) the fixed relations of the earth-moon system, (2) the stationary positions of the tides on the earth, (3) the rotation of the earth-moon-tide system, (4) the independent rotation of the earth, and (5) the movements of the earth's lands, by the earth's rotation, into and out of the stationary tidal bulges.

SOURCES OF GEOGRAPHICAL INFORMATION

W. S. DAKIN

State Board of Education
Hartford, Connecticut

TRAVEL

The original source of geographic information is travel. To be most useful this should be preceded by reading and instruction. For children the excursion offers in miniature an excellent substitute for travel as a means of gaining first hand experience. To be successful the excursion must have a definite purpose and a carefully planned procedure. In no sense should the excursion be a mere sight-seeing tour. In its best form it can be a series of lessons in observation. By careful study of the environment a teacher can select some centers of interest to be used as observation posts. These would be places where geographic conditions and relationships are best exemplified: a factory region, a point where two or more transportation lines converge, a point where land formations are conspicuous, a point where engineering skill has adapted surface conditions to human needs by bridges, tunnels, cuts and fills.

PUBLICATIONS

The commonest source of information must always be reading. Here a very important field has been neglected. Too frequently the child's only acquaintance with the literature of travel is thru the charming but verbose supplementary readers and the very concise and encyclopedic texts provided for the grades. In but few instances is there any recognition of the progress made in the teaching of reading. In speed, comprehension and range of vocabulary, pupils now frequently outrank their elders taught in the schools of a generation ago. Selections, if not entire parts of original narratives of travel, can be read with profit by children of grades six, seven and eight. The writings of Amundsen, Scott, Peary, Roosevelt and other modern explorers are as fascinating as any fictitious story of adventure ever written.

MAPS

Map study is another source of information. In certain ways the map tells far more than the printed page, particularly of funda-

mental conditions. Maps depict relationships and suggest questions and problems that stimulate the curiosity to read and know the details. To be most helpful, maps should indicate some social as well as physical facts. Maps containing both natural and human factors will present numerous problems. The following suggestions are based on a map of one small section of the United States.

1. The coast line is very regular, with almost no inlets. There must be few good harbors. We wonder if this is so? We will read to find out.
2. Most of the cities and towns are located near mountains. We wonder why? Is it on account of climate? Is it on account of mineral resources?
3. There are many rivers. This would seem to indicate a large rainfall. If there is such a rainfall there must be rich farming country or else extensive forests. We wonder if this is so?
4. There are almost as many roads running across the state north and south as there are east and west. Does this mean that the country is nearly level?
5. There is not a single lake in the whole territory. We wonder why?
6. Every large seaport is a center for several railroads. Does this mean that the products of the region are mainly exported or that it consumes great quantities of imports? These are problems for research and reading.

PICTURES

Another fruitful source of information is the picture. Pictures are often selected for the attention they will attract rather than for the information they can portray. Closeup views of buildings, machinery and crowds of people are usually of little educational value. Such pictures contribute almost no information and arouse but little curiosity. By careful selection, pictures may be chosen that will convey facts concerning modes of living, customs, and ideas of relationship. Furthermore, to children who are slow readers, a picture offers a means of securing information far more reliable than the printed page. The following suggestions for the use of pictures in geography have been found useful.

1. Does this picture tell anything about the appearance of the region being visited?
2. Is this a recent picture or was it taken some time ago? Why do you think so?
3. What does it tell about the climate of the region?
4. What does it tell about the food of the people?

5. What does it tell about the clothing?
6. What does it tell about their shelter?
7. What does it tell about travel conditions?
8. Does it tell anything about the native plant and animal life?

These and other guide questions should be used to concentrate the attention of the pupils on a picture. Ordinarily a picture should be studied by all members of the class at the same time. A few pictures well studied are preferable to a large number looked over hastily. Large views for class use are now published by some school supply companies. These can be used to instruct pupils in the method of using pictures found in their texts.

USE OF WALL MAPS IN TEACHING GEOGRAPHY

W. S. DAKIN
Board of Education
Hartford, Connecticut

Usually the wall map is merely a source of reference for pupils unable to locate places in their texts. Class exercises based on the study of a large map that all can see are well worth while. Geographic principles can be demonstrated and problems developed for study and discussion. Some suggested topics for class lessons on the wall map are:

I. Latitude and longitude markings
   1. Their significance
   2. Use to fix location
   3. Use to measure direction
   4. Use to check time
   5. Use to fix routes

II. Scale of miles
   Practice in use on wall map and book maps. Use cardboard units of measure made to scale by pupils.

III. Map facts. Show how study of type, color and location of data on map will give information concerning:
   1. Size of rivers
   2. Direction of rivers
   3. Relative size of cities
   4. Variations in altitude

5. Lines of travel
6. Probable rainfall
7. Density of population
8. Probable utility of rivers for navigation, water power
9. Slope of surface
10. Probable type of resources
11. Climate

Note: Interesting problems in comparative area may be solved by use of cardboard squares made to scale in units of area, 500 square miles, 5,000 square miles, etc. Comparative distances between cities, length of rivers, etc., can be studied with cardboard units of measure constructed according to scale of map.

Previous to a reading of the textbook it is well to discuss a map of the region to be studied, somewhat as outlined above. By skillful management the teacher can develop great interest in the problems and inferences based on map study. By encouraging pupils to hold their opinions until verified, keen interest will be aroused in reading the text. This reading will be done with a definite purpose in mind. Class discussion of the reading should follow, however, in order to insure accurate answers to the problems raised and to give credit to pupils whose inferences were correct.

Such a series of lessons if well directed will arouse the curiosity of pupils and create a desire to know more about some phase of the region studied. The teacher should observe the individual interests of pupils and plan her assignments for research that will coincide with these needs. Herein are excellent opportunities to develop outside habits of independent reading and to encourage the collection of pictures, specimens, etc.

The next natural step to be provided is some means of expression. Therefore, these research and discussion periods should be followed by periods in which pupils have an opportunity to tell, read, or write about what they have found of interest. Some may prefer to express themselves in drawing or construction. This should be encouraged even if such pupils forego some of the oral and written forms.

The final state in such a series of lessons should be provision for selection of important facts that map study, discussion, reading and reports have developed. A period may well be given to a listing of these and another to test pupils' knowledge of them. Such a test should include a measure of ability to read the map, to

recall some of the facts, and to write intelligently about a few of the problems discussed.

Another outcome that will give excellent practice is the recall and use of material in an auditorium program based on the study. In such a program can be used results of reading, written reports, art expression, literature and music. A final suggestion and caution that should be observed is that for this type of work the unit of study should be large enough to give practice in the abilities desired. If the unit is too small the problems and inferences are likely to be trivial, and the supply of reference material inadequate to meet the needs of the class. The minimum unit should be, for our own country, an entire group of states; for foreign countries, an entire topographic region, even tho this material includes more than one national boundary.

A STUDY OF CHILDREN'S KNOWLEDGE OF DIRECTIONS

GEORGE F. HOWE
State Normal School, New Britain, Connecticut

During the past decade considerable attention has been given to fundamental research in reading, spelling and arithmetic. These studies have been concerned not only with the validation of the materials of instruction but also with the determination of new and better techniques which will yield more product per unit of time, effort, and money expended. In the field of geography, however, research of this type has been very limited. Until we have matched the studies in the above mentioned fields with companion contributions in the field of geography we may expect a considerable amount of confusion in the teaching and learning of the subject, and from confusion will follow mere memorization devoid of real insight.

PURPOSE OF STUDY

The chief purpose of this study was to discover, if possible, what knowledge elementary school children have of directions both in space and on a map. A further purpose was to discover the reasons children might give for thinking that they know certain directions.

The systematic recording of the responses which children make to specific items which call for geographical information of this

particular type may be fruitful not only in revealing weaknesses in present teaching practices but also in pointing the way to new and better teaching and learning techniques. Such a study will probably be of slight value to the mature geographer who is primarily concerned with the development of the science of geography as well as the discovery of basic geographic knowledge, but from the standpoint of the teacher and learner research of this type is of the utmost importance. A study of the responses which children in the elementary school make to specific items which call for an understanding of directions may also open up the field for further study and experimentation.

The experiment described in this article was confined to a particular school system in New England. It may be argued that a duplication of this study in a somewhat different geographical setting would yield somewhat different results, but since it is not the contention of the writer that the results represent final findings the issue will not be carried further at this point. If, on the other hand, it can be demonstrated that childrens' knowledge of directions is rather limited and that wide variations in stating reasons for pointing to specific points in space and on a map actually exist, such information may furnish valuable cues for determining better teaching and easier learning of this somewhat narrow skill.

PROCEDURE

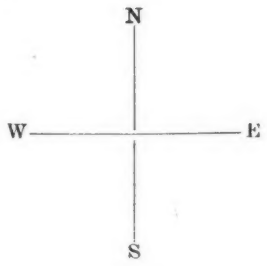
The set-up at the New Britain Normal School made it possible to carry on a study with about 1,300 children in three schools from the kindergarten thru the sixth grade. Each pupil was tested individually without the other pupils knowing what he was being asked to do. In each of the three schools all the pupils were tested the same half day in order that there should be no passing of information from one to another. This was facilitated by having the Normal School students in training assist the room teacher in carrying on the test.

The teacher was supplied with a mimeographed sheet for each child. On this sheet were four sets of cross lines, corresponding to the cardinal points of the compass, and a space where the pupil's reason could be written. The following figure shows the heading of the mimeographed sheets and the space for the first item. The other three items were recorded on blanks identical with the first, the wording of the directions indicating the response desired.

Grade..... Age..... Name .....Boy ..... Girl .....
School .....

Outdoors

Point *North*
Reason



Each child was taken out of doors and asked to point north, the teacher placing an arrow on the first set of cross lines to show the exact direction to which he had pointed. (This was done at a time when the sun was shining.) He was then asked how he knew that the direction to which he had pointed was north and his reason recorded. The same thing was repeated when the child was asked to point east, the result being recorded on the second set of cross lines.

The child was then taken to his classroom and asked to point north and how he knew it was north. If he was in the third grade or above he was asked to point to the direction east on a wall map and to give his reason.

Children in the kindergarten, first and second grade were included in this study to see whether pupils in those grades have much conception of directions before the subject is taken up by the teacher in the third grade. It was desired to try to learn whether the home or some other outside agency play a part in teaching children directions before they enter school or before they reach the third grade. Another question on which it was desired to have information was whether local objects, such as the schoolroom itself, are the sources for teaching or does the child learn to associate directions with natural objects like the sun and shadows.

From the kindergarten thru the third grade, then, children were asked to point in three directions in space and in the third thru the sixth grade to three directions in space and one on a map. The results were put on tabulating cards and from the data thus obtained various tables were made.

RESULTS

A wide variety of reasons were given by these children as to why they thought they had pointed to the right directions. Ninety-

four reasons were recorded of which twenty-nine referred to the fourth item alone, the wall map.

Apparently the home is not a large factor in developing a sense of direction since only four of the sixty-five answers relating to space show that the child had the home in mind when giving his reasons. Seventeen per cent of the reasons, eleven in number, show that the child thought in terms of local objects and in a new situation it is a question as to whether he would be able to orient himself easily. Such a local item was the one relating to the schoolroom itself or some object in the room.

The cause of local association may be attributed to the fact that the teacher used local objects in teaching directions in space, referring perhaps to some object in the immediate vicinity of the school. What is more probable, however, is that the child observed some local object as the teacher pointed out a direction in space.

Eleven per cent, or seven, of the sixty-five reasons were based upon natural objects such as the sun and wind (how one could determine a direction by noting whence the wind was coming was not decided), shadows and stars. Sixty-six per cent, forty-three in number, of the reasons were apparently meaningless to anyone but the child. In most instances the latter were given by children in the primary grades, but some were found in the upper grade responses. One boy in the fifth grade, for example, could tell directions "by a vein in my hand."

The nine responses most frequently recorded, in order of frequency, were as follows:

1. No reason given (by the child as to why he had pointed in a given direction).
2. "I don't know."
3. "I know by the sun."
4. "Wind blows that way."
5. Given direction opposite another direction, east opposite to west, for example.
6. Home faces that way (or some other reference to home).
7. Schoolroom or objects in the room.
8. Map (reference to direction of continent or some other phase of the map).
9. "It's cool there."

The first two of the above reasons make up 29.5% of the total number of responses. Number three appears to be the only way in which a direction in space could be accurately determined among the seven responses referring to space alone. Number eight refers to the fourth item, i.e., the wall map. Number five was found as a response to directions in space as well as those on a map. It was

found, too, that most of these reasons were mentioned in nearly all grades rather than being peculiar to either the primary (kindergarten thru second) or upper grades.

In other cases, however, the reasons given by children in the primary grades were distinctly different from those given by children in the upper grades. For example, "Santa Claus lives there" (the test was given in May), was distinctly from the primary grades while such an answer as "the compass" came from the upper grades. Another reason for differences in responses between the children in the lower grades and those in the upper may be attributed to the fact that the vocabulary of children in the primary grades may be somewhat limited or to the more obvious fact that formal geography is usually not introduced below the third grade.

TABLE II[1]

Reasons by Grades

Reason	K–1	K–2	1–1	1–2	2–1	2–2	3–1	3–2	4–1	4–2	5–1	5–2	6–1	6–2
1	25	46	42	81	30	26	74	89	2	33	52	23	34	89
2	8	4	25	54	30	87	48	54	73	46	59	66	28	17
3		5	9	22	18	12		36	32	116	80	86	41	77
4		6	16	42	34	45	24	22	20	15	26	16	3	12
5				1	2	16	14	41	19	31	19	31	9	37
6	3	16	11	9	8	14	7	24	9	18	6	12	5	13
7		4	3	10	1	6	10	20	13	15	10	19	9	26
8							2	8	18	26	16	23	10	20
9	2	4	8	5	8	12	3	13	8	11	17	11	10	8

The two answers receiving the highest totals, "no reason given" and "I don't know," constitute a type of response not easily analyzed but nevertheless a type which must be considered in studying a problem of this nature. However, of the children giving these replies, more pointed in the wrong direction than in the right. For instance, where no reason was given 244 were right and 402 wrong, and of the children who said, "I don't know," 216 were right and 383 wrong. On the other hand, the children who included the sun in their reasons for knowing directions were more often right than wrong, 360 being right and 174 wrong. While this result is not highly gratifying it does tend to show that the sun is a more reliable basis for determining directions than some of the other factors mentioned by children. Those children who told one direc-

[1] Part of Table II. Nine of the ninety-four reasons showing frequency by grades. Reasons 1–9 are given above.

The figure 25 opposite reason 1 and under K–1 shows that reason was given 25 times by pupils in Kindergarten–1, etc.

tion by means of another apparently had some justification in assuming they knew directions since 164 pointed in the right direction and 86 in the wrong.

The other reasons were so varied that space will not permit a discussion of them here.[2] Some of them appear to be highly illogical to adults yet they may have a very real meaning to the children who gave them. One other factor was brought out by the data; boys appear to know directions better than girls. In all four items tested more boys were right than wrong while in the case of items one and two (directions out of doors) more girls were wrong than those who were right. Whether this is because boys are out of doors more than girls and come in contact with directions thru the games they play or whether more of them are in Scout work cannot be said, but apparently boys know this phase of geography work better than girls.

TABLE III

Boys versus Girls

Number pointing correctly (R), incorrectly (W)

	Item 1[3]		Item 2		Item 3		Item 4	
	R	W	R	W	R	W	R	W
Boys	380	247	337	288	340	272	245	160
Girls	285	287	265	310	295	278	210	162

CONCLUSIONS

The following conclusions may be drawn from the assembled data:

1. Children do not know directions as well as had commonly been supposed.

2. Children do not acquire a knowledge of directions to any great extent outside the school, before taking up the study of geography, as shown by the fact that from the kindergarten thru the second grade there were more who did not know directions than those who did.

3. In grades three thru six more children were right than wrong but there was a large number of errors. This would tend to show that children have not been taught directions systematically, thoroly and accurately.

4. Children seem to have acquired the wrong associations in

[2] Mimeographed tables will be sent to anyone interested in seeing the ninety-four reasons and all of Table II. Address inquiries to the writer.

[3] Item 1, Point North, outdoors. Item 2, Point East, outdoors. Item 3, Point North, in schoolroom. Item 4, Point East, on wall map.

determining directions, thinking in terms of local objects rather than natural phenomena. Further experiments are necessary to ascertain better methods of teaching in order that proper associations may be formed.

5. Boys apparently know directions better than girls. However, this difference may be more apparent than real.

As was pointed out earlier in this article no attempt has been made to solve many of the problems which arise in connection with this experiment. The present study has simply set the stage for further experimentation on such questions as grade placement and materials of instruction. No one can say with any degree of certainty just what facts, skills, habits, attitudes or principles should be incorporated in the course of study for the elementary school.

If we fail to address ourselves to the task of determining the kind and amount of geography necessary as well as ascertaining the best teaching and learning techniques which will insure a mastery of those elements which are regarded as of fundamental importance to elementary school children, we are falling short of what is expected of us. The kind of textbook teaching which obtained in the past does not fit the demands of a constantly changing civilization. The geography of the future must be based upon factors which have been determined thru experimentation and have proof that they are of value to the individual. For the most part there has been a definite break with the geography teaching of the past and that break must be clean-cut and lasting. The new geography must justify its place in the curriculum.

While the present study makes no attempt to set up dogmatic standards or methods it is hoped that it may be taken as representative of the start which must be made in order to answer some of the problems to which educators are looking to the expert geographer for information and guidance.

EDITORIAL NOTES AND NEWS

The following are a few odds and ends gleaned from recent Commerce Reports which may be of interest to some of our readers. Perhaps they can serve as topic sentences around which your students can build geographic concepts of the places mentioned.

The term "Malaysia" as used by the Department of Commerce includes the Netherland East Indies, British Malaya, Siam, and French Indo-China. Its rubber, tin, fibers, and vegetable oils are of particular importance to the United States.

Did you ever wonder at the source of frankincense and myrrh? Half of the world's supply comes from Italian Somaliland. In its forests grow several varieties of "bush" plants yielding highly fragrant resins and balsams from which the incense is obtained.

The pineapple harvest of Hawaii is at its peak in July and continues thruout August. This season's yield is high and of excellent quality.

Owing to drought on breeding areas, this year's hunting season of waterfowl has been reduced to one month.

Attention has been previously directed to the list (available free to geographers) of the correct spelling of foreign geographical names, prepared under the direction of Dr. Helen Strong, Geography Section, Department of Commerce. This list also appears in the September, 1931, *World's Work*.

The Netherlands sent 36 tons of strawberries by airplane to London during May, 1931. They also send by plane large consignments of flowers to the various markets of Europe.

Two years ago the Norwegian Storting voted to change the name of the city of Trondhjem to Nidaros. A short time ago an attempt to have the former name restored to the city failed. As a compromise the name of Trondheim was adopted.

When Kipling wrote "On the Way to Mandalay" there was no 275 mile long pipe line conveying oil from the principal Burmese field at Yenangyaung to the refineries at Rangoon. Most of the kerosene derived therefrom goes to India proper. Their rice harvest, too, exceeds their home needs, and so does their cutting of teakwood. Of what significance is the fact that the Simon Commission recommends that Burma be separated from India? Have your Asia pupils given geographic reasons why this separation would be wise or unwise?

One of the world's novel farms is the snake farm, Instituto Butantan, near Sao Paulo. Here serums are prepared from snake venoms to combat snake poisoning in the snake-infested parts of Brazil. Snakes transported thither free by the railroads arrive daily to maintain the number needed to produce the venom; for deadly snakes do not live long in captivity. Started privately, the farm is now a Government institution.

Those desiring addresses of foreign publishers of foreign maps may write Miss Helen Strong, Chief, Geographic Section, Division of Statistical Research, Department of Commerce, Washington, D.C. The information is in three lists, Geographic News No. 4, 5, and 6. Miss Strong has a number of copies of a circular, Russian Economic Notes, No. 140, covering "Progress in Construction of Magnitogorsk and Kuznetsk Steel Mills," taken from the original Russian source, for distribution to geographers.

New motion pictures of sugar and cotton, and an audio film on earthquakes are available from Films of Commerce, Inc., New York. These films were made under the supervision of Kirtley F. Mather, Chairman, Department of Geology and Geography, Harvard University. The premier showing of these films was made at the Harvard summer session in the new Geography Building at Cambridge.

Have you used the National Geographic Society News Bulletins? They are issued weekly during the school year and give late news on boundary changes, geographic developments, and world progress in other lands. The price is 25 cents for the 30 weeks service.

Train telephone service is in operation on Canada's fastest train, The International Limited, which makes the 350 mile run between Toronto and Montreal in 6 hours. Conversations have been made with parties overseas as well as in many parts of the United States and Canada.

Teachers who are eager to obtain maps and photographs of American ports, as well as recent data on the flow of commodities thru these gateways, will welcome the 1930 revision of several port studies prepared by the United States Army and the United States Shipping Board, and on sale by the Superintendent of Documents, Washington, D.C. Panoramic and aeroplane photographs of unusual scope and detail are found in Port Series No. 8, Part 2 for Miami and Tampa, Florida (40 cents); in Port Series No. 13, Part 1, for Los Angeles and Long Beach, California (60 cents); and in No. 13, Part 2, for San Diego and San Luis Obispo, California (45 cents). Port and Terminal Charges at United States Ports, Miscellaneous Series No. 1 ($1.25), tho lacking maps and photographs, gives brief, pointed descriptions of the harbor conditions, port equipment and foreign trade of all United States ports.

The United States Shipping Board has issued a revision of the bulletin entitled Transportation on the Great Lakes, Transportation Series No. 1 ($1.50, Superintendent of Documents). It is a valuable source of information on the physical character of the waterway, the commerce of the principal ports, and the grain, ore, coal, package freight and car ferry traffic. Also, it is well illustrated with useful photographs and maps. Particularly noteworthy are the maps which show the movement of wheat, iron ore, coal, etc. These are drawn on a scale sufficiently large to permit their use in the classroom.

Plan to Go to Ypsilanti

The Annual Meeting of the National Council of Geography Teachers will be held Monday and Tuesday, December 28 and 29, at State Normal College, Ypsilanti, Michigan. The program of Monday deals with the curricula of geography in the Elementary School, Junior High School, and Senior High School. The program of Tuesday deals with various problems of geography teaching. The Annual Dinner will be held on Tuesday evening. The meetings are open to all who wish to come.

The College dormitory and dining hall will provide comfortable living quarters and good meals at reasonable prices to all who can attend.

Further details of the program will be given in the November JOURNAL. Plan now to attend this meeting.

DOUGLAS C. RIDGLEY

GEOGRAPHICAL PUBLICATIONS

L. Wood Gordon. **The Pacific Basin.** 340 pp.; 180 figures, mostly photos, brief bibliographies, and index. Oxford University Press, New York, 1930. $4.00

This brief book by an Australian economist sketches briefly the geographical backgrounds of the vast area within and adjacent to the Pacific, including much of Asia and western North and South America. The book will be of service as collateral reading for elementary pupils. The photos are excellent. The 85 pages on Australia and New Zealand and the 58 pages of "General Survey of the Pacific Environment" are especially likely to be useful.

Indiana University STEPHEN S. VISHER

Robert Briffault. **Rational Evolution.** 302 pp.; index. The Macmillan Company, New York, 1930. $3.50

This is a revision of "The Making of Mankind," issued in 1919 in England. It is a profound study which is of interest to geography teachers because it deals with such an important subject, and especially because it emphasizes the great effects upon rational evolution of three influences which are geographic in essence. The independence of thought of many of the Greeks, which entitles them to be called "the first moderns," is ascribed by the author to the geographic setting. The Greeks could readily accept what they wished of Oriental ideas but their protective locations permitted them to reject the ideas and forces of authority which stifled progress in the Orient. Priests and monarchs seldom dominated the ancient Greeks. They cared litt'e for authority, but cared much whether or not the idea seemed rational. The location of the various tiny city-states on the diminutive coast plains of a rugged land not far from the Orient, but scarcely conquerable by the Orient, was of fundamental importance to the Greek development.

The author accredits the Mohammedans with having awakened Europe from the lethargy of the Dark Ages and with having profoundly advanced rational evolution. As one of the major objectives of geography instruction is to increase appreciation for other peoples, this tardy recognition of the contribution of the Moslems will be welcomed and passed on by many geography teachers. The Moslems advanced rational evolution by gathering concrete facts by observation and some experimentation, and from the writings of Greeks and Orientals. They disseminated widely the scientific facts at popular universities in Moorish Spain, Alexandria, Sicily and elsewhere, and by books. For a century before the Renaissance the Moors were the chief advanced "teachers" of Europe. The indirect effects of the capture of Constantinople and Jerusalem, and of the Crusades which resulted therefrom were also important, as was the effect of their interference with the overland trade with India, but these indirect effects, commonly the only ones mentioned, are of far less importance, Briffault believes, than the direct ones mentioned above, and the effects of Moslem trade.

The third great influence of geographic origin considered of especial importance in advancing rational evolution was the growth of commerce, accompanied as it was with the growth of knowledge, the exchange of ideas, and the accumulations of wealth. Briffault considers that the Moslems were highly influential in bringing this about, although European trade soon grew far greater than Moslem trade had been. Briffault considers that any influence which favored the accumulation of wealth, such as the use of coal for power, and the use of rich soils in favored climates, made possible by improvements in transportation, also advanced rational evolution.

Indiana University STEPHEN S. VISHER

C. F. Talman. **The Realm of the Air.** 328 pp. 29 photos. Index. The Bobbs-Merrill Company, Indianapolis, 1931. $4.00

The distinguished Librarian of the United States Weather Bureau has for several years been writing interesting brief accounts concerning the weather for Science Service, which accounts are published in many daily newspapers under "Why the Weather?" From time to time he has combined and revised some of these for magazines, and the Sunday papers. This book is a further combining and revision of some of this material.

"The Realm of the Air" presents in excellent literary form, with choice photographic illustrations, accurate descriptions of numerous interesting phases of the weather and their effects. Of especial value to geography are the intimate accounts of how human activities are affected by the air and conditions caused by the air. Another notable feature of the book is the brief attractive historical sketches of the growth of our knowledge in respect to various atmospheric phenomena, such as storms, haloes, lightning, and weather forecasting.

"The Realm of the Air" is a worthwhile addition to any school or private library as its thirty chapters deal with such interesting topics, the style in which it is written is so delightful, the information presented is so scientifically accurate, and its illustrations are so well selected. It is strongly recommended for geography teachers and geographic libraries in particular because of its excellent presentation of numerous accounts of the effects of the environment.

Indiana University STEPHEN S. VISHER